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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/GB88/01066</p> <p>(22) International Filing Date: 2 December 1988 (02.12.88)</p> <p>(31) Priority Application Number: 8728167</p> <p>(32) Priority Date: 2 December 1987 (02.12.87)</p> <p>(33) Priority Country: GB</p> <p>(71) Applicant (for all designated States except US): THE SECRETARY OF STATE FOR DEFENCE IN HER BRITANNIC MAJESTY'S GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND [GB/GB]; Whitehall, London SW1A 2HB (GB).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only) : WHYNTIE, Adrian [GB/GB]; 12 Sandy Lane, Titchfield, Fareham, Hampshire (GB).</p>		<p>(74) Agent: LOCKWOOD, Peter, Brian; Ministry of Defence, Procurement Executive, Patents 1A(4), Room 2014, Empress State Building, Lillie Road, London SW6 1TR (GB).</p> <p>(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</p> <p>Published With international search report.</p>
<p>(54) Title: BUOY AND WATERCRAFT DRIFT WARNING SYSTEM</p> <div data-bbox="483 1113 1218 1596"> </div> <p>(57) Abstract</p> <p>A drift warning unit for a buoy or vessel (1) positioned remotely from a central monitoring unit (2) comprises a global positioning system (GPS) receiver (or receiver acting as a relay) (3), positioned on the buoy (1), which receives global positioning information from earth satellites. A presetter (4) enables the desired latitude and longitude co-ordinates of the buoy (1) to be set. The central unit (2) includes a receiver/transmitter (6) for receiving and transmitting data over a data link (5). A processor (7) is programmed to store the positional data relating to the buoy (1) when it is set in its initial position and it activates an interrogator (8) at regular intervals. The interrogator (8) causes an interrogation signal to be sent over the data link (5) to the buoy (1), which is then input to a transponder (9) which activates a transmitter (10) to transmit GPS positional data relating to the buoy (1) back to the central unit (2). The GPS data is received by the receiver (6) and input to the processor (7), which then compares the present position of the buoy (1) with the stored initial position and if the present position is outside a preprogrammed error range the processor displays a warning signal on a display (11). The system uses GPS in what is called the Differential Mode.</p>		

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BUOY AND WATERCRAFT DRIFT WARNING SYSTEM

The present invention relates to the monitoring of the positions of buoys, such as navigation buoys, or watercraft that are moored or anchored, for example ships in a harbour or yachts in a marina.

An essential feature of any navigation buoy is that its exact position is known and maintained. At present, buoys must be checked physically at regular intervals to check that they have not drifted. In rough weather it can be impossible to check the buoys and, as that is the time that they are most likely to drift, dangerous situations can develop.

Drifting of moored or anchored watercraft can also cause problems. There are thousands of craft moored or anchored at any one time and the losses caused by drifting of craft are considerable. The checking of craft in harbours, marinas, etc relies on visual checks and it is difficult for comprehensive checks to be carried out regularly.

The object of the invention is to provide a means of automatically checking the position of a buoy or craft and providing a warning if it has drifted.

The invention provides a drift warning system for a remote unit comprising:

- a) means to determine the position of the remote unit;
- b) means to store an initial position of the remote object;
- c) means to compare the present position of the remote unit with the initial position; and
- d) means to activate a warning signal if the present position is outside a predetermined error range from the initial position.

The remote unit itself may be a buoy or any type of watercraft such as a ship or a yacht.

Preferably the means to determine the position includes a receiver,

mounted at the remote unit, responsive to global positioning information transmitted by earth satellites.

Advantageously the receiver is responsive to global positioning information from a Global Positioning System used in the Differential Mode to detect changes in the position of the remote unit, as this provides greater positional accuracy.

Preferably a central monitoring unit is provided at which a warning signal is activated and which can monitor several remote units concurrently.

The receiver may include its own processing capability but advantageously it acts as a relay such that all the information received from satellites is passed via the relay and processed at the central monitoring unit.

Preferably the means to store the initial position and the means to compare the present and initial positions of the remote unit comprise processing means, such as a programmed microprocessor.

Preferably the initial position of the remote unit is entered into the processing means when the remote unit is set in place, moored or anchored as the case may be. Preferably allowable errors from the initial position are programmed into the processing means.

If the processing means detects an error in the remote station position it triggers a warning signal. The processing means may be at the central monitoring unit or at the remote unit.

If the processing means is at the central unit the central unit preferably includes a transmitter to transmit interrogation signals to the remote unit and a receiver to receive positional information from the remote unit. The remote unit includes a transponder responsive to the interrogation signals from the central unit and a transmitter to transmit data relating to its position to the central unit, which is activated by the

transponder in response to an interrogation signal from the central unit. The remote station unit can be interrogated on demand or by repeated automatic interrogations.

If the processing means is at the remote unit the remote unit preferably includes means to enter the initial position into the processing means when the remote station is set in position or moored etc. The remote unit also includes a transmitter to transmit information to the central unit and advantageously also includes warning signal means at the remote station. If the processing means detects an error in the remote unit position the processing means activates the transmitter to send a signal to the central unit to activate the warning signal. Advantageously the transmitter also transmits data identifying the remote unit and detailing the positional error.

The remote unit processor automatically informs the central unit if there is an error in position. Alternatively the remote unit may also include transponder means responsive to interrogation signals from the central unit which activates the transmitter to transmit positional data to the central unit in response to an interrogation signal. This enables the remote unit positions to be checked on demand or scanned automatically.

If the remote unit is a navigation buoy a warning signal at the buoy can be effected by the processing means causing the visual signalling to be altered, to alert shipping that the buoy is off station.

The warning signal at the central unit may be of any convenient form such as an audio or a visual alarm.

Advantageously display means may be provided at the central unit to display positional data relating to a plurality of remote units.

The invention will now be described, by way of example only, with reference to the drawings of which:

Figure 1 shows a schematic diagram of one form of a buoy drift

warning system according to the invention; and
Figure 2 shows a schematic diagram of an alternative form of a buoy drift warning system.

As shown in Figure 1 a buoy is positioned remotely from a central monitoring unit 2. Mounted in the buoy 1 is a global positioning system (GPS) receiver (or receiver acting as a relay) 3 which receives global positioning information from earth satellites. A presetter 4 enables the desired latitude and longitude co-ordinates of the buoy 1 to be set. A data link 5 links the buoy 1 with the central unit 2. The central unit 2 includes a receiver/transmitter 6 for receiving and transmitting data over the data link 5. A processor 7 is programmed to store the positional data relating to the buoy 1 when it is set in its initial position. The processor 7 is programmed to activate an interrogator 8 at regular intervals. The interrogator 8 causes an interrogation signal to be sent over the data link 5 to the buoy 1. The interrogation signal is input to a transponder 9 which activates a transmitter 10 to transmit GPS positional data relating to the buoy 1 back to the central unit 2. The GPS data is received by the receiver 6 and input to the processor 7. The processor 7 then compares the present position of the buoy 1 with the stored initial position and if the present position is outside a preprogrammed error range the processor displays a warning signal on a display 11. The system uses GPS in what is called the Differential Mode. The buoy 1 also includes a battery power supply 12.

Figure 2 shows an alternative buoy drift warning system that is particularly suitable for major navigation buoys. A buoy 21 is located remotely from a central monitoring unit 22. The buoy 21 contains a GPS receiver 23 for receiving information from earth satellites. A presetter 24 enables the latitude and longitude co-ordinates of the buoy's initial position to be input to a processor 25. The GPS data received by the receiver 23 is input into the processor 25 and compared with the initial position. If the present position of the buoy 21 is outside a preprogrammed error range from the initial position the processor 25 activates a transmitter 26 which transmits information identifying the buoy and detailing the positional error via a data link 27 to the central unit 22.

The processor 25 also instructs a flash control unit 28 to alter the visual signal produced by a flashing light 29 to indicate that the buoy 21 is off station.

The information transmitted to the central unit 22 is received by a receiver 30 and input to a processor 31. The processor 31 displays the information on a display 32 and displays a warning that a positional error has been detected.

The buoy equipment is powered by a battery power supply (not shown).

The invention has been described in relation to a buoy drift warning system but is equally applicable to drift warning systems for all types of watercraft such as ships, yachts etc in harbours, rivers, marinas and so on.

It has many advantages including its flexibility and its ability to allow automatic warning to be given of drifting before potentially dangerous situations can develop.

CLAIMS

1. A drift warning system for a remote unit characterised in that it comprises:
 - a) means to determine the position of the remote unit, including a receiver, mounted at the remote unit, responsive to global positioning information transmitted by earth satellites;
 - b) means to store an initial position of the remote object;
 - c) means to compare the present position of the remote unit with the initial position; and
 - d) means to activate a warning signal if the present position is outside a predetermined error range from the initial position.
2. A drift warning system according to claim 1 characterised in that a central monitoring unit is provided.
3. A drift warning system according to claim 1 or claim 2 characterised in that the receiver is responsive to global positioning information from a Global Positioning System used in the Differential Mode.
4. A drift warning system according to any one preceding claim characterised in that the receiver acts as a relay such that all the information received from satellites is passed via the relay to the central monitoring unit.
5. A drift warning system according to any one preceding claim characterised in that the means to store the initial position and the means to compare the present and initial positions of the remote unit comprise processing means, such as a programmed microprocessor.
6. A drift warning system according to claim 5 characterised in that the initial position of the remote unit is entered into the processing means when the remote unit is set in place, moored or anchored.
7. A drift warning system according to claim 6 characterised in that

allowable errors from the initial position are programmed into the processing means.

8. A drift warning system according to any one of claims 5 to 7 characterised in that a warning signal is triggered if the processing means detects an error in the remote station position.

9. A drift warning system according to any one of claims 5 to 8 characterised in that the processing means is at the central monitoring unit.

10. A drift warning system according to any one of claims 5 to 8 characterised in that the processing means is at the remote unit.

11. A drift warning system according to claim 9 characterised in that the central unit includes a transmitter to transmit interrogation signals to the remote unit and a receiver to receive positional information from the remote unit.

12. A drift warning system according to claim 11 characterised in that the remote unit includes a transponder responsive to the interrogation signals from the central unit and a transmitter to transmit data relating to its position to the central unit, which is activated by the transponder in response to an interrogation signal from the central unit.

13. A drift warning system according to claim 12 characterised in that the remote unit includes means to enter the initial position into the processing means when the remote station is set in position or moored etc.

14. A drift warning system according to claim 10 or claim 13 characterised in that the remote unit includes a transmitter to transmit information to the central unit.

15. A drift warning system according to claim 14 characterised in that there is included warning signal means at the remote station.

16. A drift warning system according to claim 14 or claim 15 characterised in that the processing means activates the transmitter to send a signal to the central unit to activate the warning signal if the processing means detects an error in the remote unit position.

17. A drift warning system according to claim 18 characterised in that the transmitter also transmits data identifying the remote unit and detailing the positional error.

18. A drift warning system according to any one of claims 14 to 17 characterised in that the remote unit processor automatically informs the central unit if there is an error in position.

19. A drift warning system according to any one of claims 14 to 18 characterised in that the remote unit includes transponder means responsive to interrogation signals from the central unit which activates the transmitter to transmit positional data to the central unit in response to an interrogation signal.

20. A drift warning system according to any one preceding claim characterised in that the remote unit is a buoy.

21. A drift warning system according to any one of claims 1 to 19 characterised in that the remote unit is a ship or a yacht.

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Fig.1

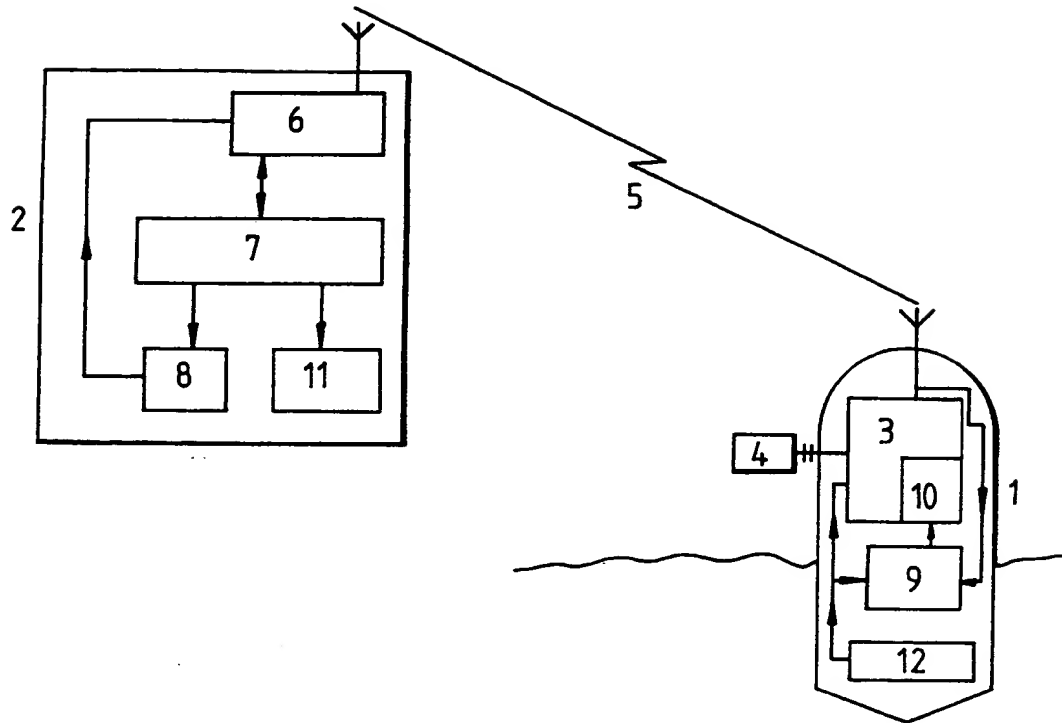
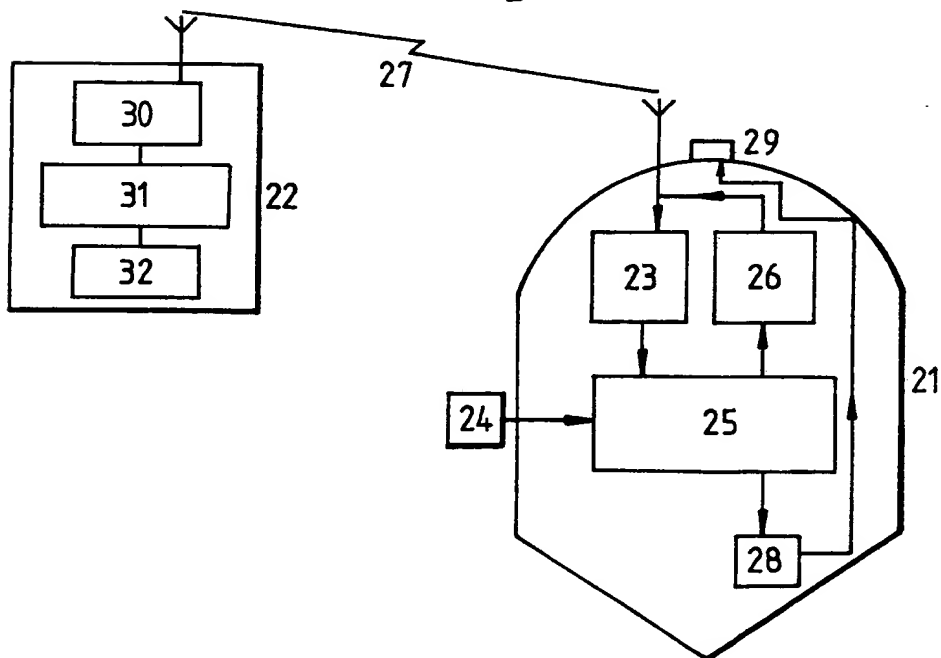


Fig.2



SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/01066

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) * According to International Patent Classification (IPC) or to both National Classification and IPC IPC4: G 01 S 5/14, G 08 B 25/00		
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched †</div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">Classification System ‡</div> <div style="width: 50%;">Classification Symbols</div> </div> <div style="margin-top: 10px;"> IPC4 G 01 S; G 08 B </div> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin-top: 10px;">Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *</div>		
III. DOCUMENTS CONSIDERED TO BE RELEVANT*		
Category *	Citation of Document, †† with indication, where appropriate, of the relevant passages ‡‡	Relevant to Claim No. ‡‡
X	US, A, 4651157 (D. GRAY ET AL) 17 March 1987, see column 3, line 11 - line 29; column 3, line 52 - line 59; column 5, line 35 - column 6, line 23; column 9, line 41 - line 66; figure 1	1-8,10, 14-21
Y	--	9,11-13
X	EP, A2, 242099 (ADVANCED STRATEGICS, INC) 21 October 1987, see page 4, line 34 - line 39; page 5, line 40 - line 50; figures 1,5	1-3,5-8, 10,14, 16-19
Y	US, A, 4622557 (E. WESTERFIELD) 11 November 1986, see column 4, line 58 - column 5, line 5; column 7, line 14 - line 51; figures 3,6	9,11-13

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IV. CERTIFICATION		
Date of the Actual Completion of the International Search 2nd March 1989		Date of Mailing of this International Search Report <div style="text-align: right; font-weight: bold; font-size: 1.2em;">23 MAR 1989</div>
International Searching Authority <div style="text-align: center; font-weight: bold; font-size: 1.1em;">EUROPEAN PATENT OFFICE</div>		Signature of Authorized Officer <div style="text-align: center;"> <div style="text-align: right; font-weight: bold; font-size: 1.1em;">P.C.G. VAN DER PUTTEN</div> </div>

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 12/01/89. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4651157	17/03/87	NONE	
EP-A2- 242099	21/10/87	JP-A- 63024395	01/02/88
US-A- 4622557	11/11/86	NONE	